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EDITORIAL NOTES

PURIFICATION

THE purification of gas by oxide of iron may appear on the face of it a simple operation; in fact, it is highly complicated, and has considerable bearing on the economics of gas manufacture. We remember an important contribution to the subject some time ago by Mr. R. H. Clayton and co-workers, in which were set out no fewer than 35 chemical equations representing reactions which can occur during the purification process, and though some of these reactions are of comparatively minor importance under normal working conditions, they may assume great significance under unusual conditions. There are several inter-related factors playing their part—moisture, ammonia, physical condition of the oxide mass, temperature, tar, and so on—and efficient working calls for accurate technical control. On later pages to-day we publish an abstract of a Paper by Mr. C. Cooper—a further addition to several outstanding contributions given since the war to the Junior Associations—in which he discusses the effect of "wet purification" on "dry purification." The points he makes are many and they are technically important.

How, for example, does ammoniacal liquor assist dry purification by removing sulphuretted hydrogen in the initial changes? The answer, given quite simply by the Author, to this question is "hardly at all," for operating conditions to-day are very different from what they were before the last war; the differences in this respect are succinctly summarized in the Paper. Not that the operation of ammonia washers in regard to dry purification is unimportant. A definite though small quantity of ammonia is needed for the efficient working of oxide boxes, and to ensure this "definite amount" careful control of the washers is necessary. Relatively small differences in the rate of water flow in the washers result in great differences in performance. A washer operating on an ammonia content of 1 grain per 1,000 cu.ft. of gas at the outlet passes to a state of 30 grains slip with a temperature rise of only 15°F. The need for, and the difficulties of, correct adjustment become apparent. Efficiency depends on close technical control based on a thorough understanding of the purifying process—wet and dry—as a whole. Then there is the question of tar, a great enemy of efficient dry purification. Here the Author puts forward a most interesting observation, and it relates to the resistance to be overcome in mechanical types of tar extractor compared with the electrical precipitation type. Every measure which increases the cleanliness of gas at its entry to the oxide boxes is worthy of following up consistently, and nobody would query the efficiency of electrical precipitation of tar. But has the cost of this measure of purification been exaggerated? To overcome the back-pressure of mechanical types calls for considerable power consumption—and power costs money. Again, if by efficient tar removal we reduce back-pressure on the purifiers, we save power costs. Further, the absence of tar means cheaper purification, because the oxide is used to better advantage and the spent material is more acceptable to the buyer. We have mentioned temperature control in the boxes, which is bound up also with humidity control; and on this matter the Author suggests that many gas heaters for the purpose only foster an illusion in the heart of the user. For example, the practice is to heat the gas at the entry of the first box—in other words, where it is least needed. To effect close temperature control it would appear desirable to protect the boxes against heat loss and to reheat between boxes.

We have touched upon a few of the points made by Mr. Cooper by way of calling attention to a Paper which calls for study, promotes thought, and emphasizes once again the need for control, and more control technically combined with knowledge other than superficial. And it leads up to a general note concerning to what extent the Gas Industry could adopt purification and recovery processes which will bring out more directly marketable chemical substances, for it is a fact that few of the residuals of gas manufacture can go into the chemical market without a good deal of secondary preparation.

PRODUCTS FROM COAL AND OIL

AT a time when considerable thought is being given in an attempt to visualize the fuel industries as a whole, each being used in the spheres for which it is best fitted, it is interesting to turn to the Paper which Mr. Harold Moore gave yesterday at a meeting of the Institute of Fuel. An abstract will be found on later pages of to-day's "JOURNAL." His subject was the production of liquid fuels and organic chemicals from coal and refined petroleum, and his arguments were advanced in a very clear manner. Regarding products from coal, he discussed carbonization, hydrogenation, and the Fischer Tropsch process. Hydrogenation, he pointed out—and it is well to remember this—involves the consumption of over three tons of coal for every ton of liquid hydrocarbon produced, and the thermal efficiency is only of the order of 40%, while the thermal efficiency of the Fischer Tropsch process is no higher. On the other hand, the process efficiency of carbonization is already very high and is likely to become even higher, and obviously increase in carbonization would automatically augment liquid fuel supplies and increase the quantity of phenols, cresols, and other organic bases for the chemical industry. The advantages to be gained by carbonizing coal in place of burning it domestically in the raw state are so great and so far-reaching that the use of the power of the State to eliminate wasteful utilization is surely justified and employment would be increased. Research and experiment on both hydrogenation and the Fischer Tropsch process are fully warranted, but let us concentrate practically on a greater measure of carbonization.

It might be feared that the extension of the carbonizing industry on the scale envisaged in the Paper would result in too great a production of coal tar and would thereby depress the markets for the tar products. Mr. Moore suggested that the likelihood of this occurring is not really serious. Greater production, he argued, can hardly affect the price of benzole and toluole. The motor and aviation spirit markets are capable of absorbing twelve times the present production, and further quantities of benzole will be required for the manufacture of synthetic phenol required by the growing plastics industry and for making styrene, an ingredient of the rubber substitute Buna-S. Naphthalene is wanted in large quantities for the manufacture of phthalic acid and phthalic anhydride—again used in the plastics industry. And during the war experience has been gained in the burning of both pitch-creosote mixtures and pitch.

The synthetic organic chemical industry has largely been built upon the basis of the coal-tar products, particularly the bodies which are easily separated in a pure form. Under peacetime conditions the demand for the fine chemicals might reasonably be expected to undergo a regular increase, while the plastics industry may be expected to grow at a much more rapid rate on account of the nature of the market for plastics. Mr. Moore maintained, however, that there exists a large field of organic chemicals which cannot be economically made from coal tar. These compounds, the aliphatic bodies, require some other starting-point, and the petroleum industry does provide a good starting-point for the preparation of many organic compounds. This led the Author to his next main suggestion—together with

extended carbonization, the creation of a home petroleum refining industry. Coupled with legislation against the burning of raw bituminous coal, he would like to see some form of preferential duty in favour of petroleum products refined in this country from imported crude. He argued that many of the products which can be made in quantity from petroleum do not affect existing markets; as they are new bodies which have hitherto not been available in quantity, the coal tar industry has little to fear, for the petroleum products are mainly complementary and not substitutes for the coal-derived bodies. And he would have refineries near the centres of consumption, near gas-works which could take surplus gas, and capable of establishing subsidiary chemical industry. Space limitations have made it necessary for us to give an abstract only of the Paper, but it is a fairly full one, and we think it will interest not only the Gas Industry, but the fuel industries generally.

Electricity Supply after the War

The Institution of Electrical Engineers, in a report on the reorganization after the war of electricity supply, puts first among matters of immediate urgency the extension throughout the country of the agreed national standard for low-voltage distribution systems. No technical difficulties stand in the way, and standardization could be completed within five years. The cost is estimated, on the basis of 1939 conditions and prices, at £17,500,000. It is suggested that as the benefit of standardization accrues to the community as a whole, there should be financial discussions with the Government.

For the completion of rural electrification financial aid will be required. Wayleave procedure should be simplified. Legislation is recommended to bring English law into conformity with Scottish, which allows a tenant to secure compensation from the landlord for the cost of any wiring installation. Low interest terms for wiring or hire-purchase terms are advocated. The report says the time is ripe for securing uniformity of forms of tariff. Consumers are classified as domestic, farm, industrial, and commercial, and there are recommendations for the equitable assessment of the fixed component of the charges equitable in each group. The Electricity Commissioners, it is urged, should be authorized to permit any undertakings to offer a two-part tariff only, with no alternative flat rate.

Personal

Brigadier E. M. JACK, C.B., C.M.G., D.S.O., D.L., has been elected Chairman of the Southampton Gaslight and Coke Company in succession to the late Sir Russell Bencraft, J.P., who held the office for the past 16 years. Brigadier Jack, who has been a Director since 1932, is succeeded as Deputy Chairman by Mr. T. CARMICHAEL, M.Inst.C.E., J.P., Managing Director and Deputy Chairman of the Portsmouth and Gosport Gas Company. The vacancy on the Board has been filled by the election of Mr. W. R. D. PERKINS, M.P. Mr. S. E. WHITEHEAD, B.Sc., M.Inst.C.E., J.P., who has been Engineer and General Manager since 1932, has been appointed Managing Director, and Mr. G. NEIL, Deputy Engineer, becomes Engineer to the Company.

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The Directors of the Newcastle-upon-Tyne and Gateshead Gas Company have elected Mr. E. CROWTHER, the General Manager and Chief Engineer of the Company, to a seat on the Board.

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Nearly half a century of service with the Rochester, Chatham, and Gillingham Gas Company comes to an end with the retirement of Mr. W. BROADBRIDGE, local Secretary of the Company since the death of Mr. C. Valon Bennett in 1940. On Jan. 28 a staff presentation was made by Mr. G. le B. Diamond, the General Manager.

* * *

At a meeting of the Plymouth Corporation Gas Committee on Jan. 27, Sir CLIFFORD TOZER, who has been Chairman for 21 years, announced his impending resignation from the Committee in view of his appointment as leader of the City Council. A resolution was passed thanking Sir Clifford for his past services.

* * *

Two more employees of the Plymouth and Stonehouse Gas Light and Coke Company have received honours for the heroic part they played during heavy air raids on the city. They are Mr. ERNEST ALEXANDER WEBB, aged 37, mains foreman and A.R.P. duty official, and Mr. PERCY VICTOR TRIPP, aged 51, emergency escape service layer and rescue party leader, who have been awarded the British Empire Medal (Civil Division) for devotion to duty and complete disregard of personal safety.

Obituary

The death has occurred of Dr. BIRKETT WYLAM, M.Sc., Ph.D., F.I.C., M.I.Chem.E., F.C.S., Chief Inspector of Alkali Works and Rivers Pollution, Department of Health for Scotland. Dr. Wylam was a graduate of Durham University. He began his professional career as research chemist to Morton Sandour Fabrics, Ltd., and later was research chemist and process manager at Scottish Dyes, Ltd. (I.C.I., Grangemouth). He left this post to take up his professional duties with the Department of Health for Scotland in 1931. During the last war Dr. Wylam served with the Royal Garrison Artillery in France.

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Mr. R. M. HOLLAND-MARTIN, Deputy Chairman of Martins Bank, Ltd., and Chairman of the Southern Railway, who died suddenly on Jan. 27, was a Director of the Gas Light and Coke Company.

Letters to the Editor

Scottish Salesmen's Circles

DEAR SIR,—I have been asked to arrange a meeting of Scottish salesmen in the near future. It is some considerable time since a meeting was held and numerous changes have taken place, with the result that a proper roll of members is not available.

The proposal is to hold a meeting in Glasgow or Edinburgh, and an excellent speaker has been arranged.

Will all members of sales staff who are interested, and could attend such a meeting, please advise the undersigned, stating which city would be more suitable, and if it would be possible for them to attend a meeting held on an afternoon during the week.

522, *Sauchiehall Street*, *Glasgow, C.* 2.
Jan. 24, 1944.

Yours faithfully,
ALEX. BUJNOWSKI, Secretary,
Scottish Gas Development Centre.

Initiative and Seniority

DEAR SIR,—"Technician" advocates compulsion by somebody unnamed for purposes unspecified in the reorganization of our Industry. Surely we now live under a sufficiency of compulsions without inviting more. Its extension in the affairs of our Industry would be defensible only if we show ourselves incapable of voluntary co-operation and effort. I sympathize with "Technician's" impatience and his wish for compulsion to expedite his own pet scheme, but it might favour some other scheme to which he is opposed and to which he could then offer no effective resistance.

So important is our actual and potential contribution to the national welfare that unless we show ourselves alive to our responsibilities compulsion must be thrust upon us. What an opportunity for voluntary development would then be permanently lost.

Current discussions, however acrimonious, are surely a proper and healthy part of our planning and progress in a democratic regime. I venture to add three further suggestions:

First, let us cease to imagine we can solve knotty problems by appointing committees. Such bodies form useful means for discussion and for approving or disapproving policy, but they cannot of themselves be creative. For that we need, not sporadic spare-time effort, but the intensive application of individuals.

Secondly, we have acquired a tradition that only those very senior in age and position should take the initiative. It shows no disrespect to them to suggest there are other talents we should also use. Alexander the Great died at 33. William the Conqueror was in his thirties at the Battle of Hastings. Pitt became Prime Minister at 25. Murdoch was less then 40 when he first usefully applied gas lighting. Winston Churchill entered the Cabinet in his thirty-fourth year. The Foreign Secretary after ten years in Cabinet rank would still seem immature in years on our councils. Hence surely we might, with advantage, introduce some younger men into even our highest deliberations, especially since it is primarily they who will have to operate the long-term policies now conceived.

Finally, we declare it appropriate and in the national interests that our fuel services to the public should be greatly expanded, yet in detail we hesitate. Since we are all human it may well have been the lack of any particular or personal incentive favouring expansion which has tolerated such caution in our major policy. If the chief executive of each undertaking received a bonus based on increase in gas sales, when expansion once more becomes practical politics, a more progressive tradition might soon become established. The new British Gas Association might consider forfeit of the first year's subscription on all such increases for this purpose.

May I add, I am myself in years no junior, and in position no chief executive, so my suggestions serve no personal motive (unless they help to save me from compulsion and authoritarian rule !)

Jan. 28, 1944.

Yours faithfully,
"X."

National Federation of Gas Coke Associations

The following abstract is taken from the annual report of the General Committee which has just been published for the year ended June last. The Federation, in conjunction with its District Coke Association members, has been engaged in furthering the national interests of the gas coke industry and in assisting with the complex problems arising from wartime conditions. The Federation was formed such a short time prior to the war that its work to date has of necessity been concerned mostly with matters relating to wartime controls and restrictions and negotiating with the Ministry of Fuel and Power, but during the past year there has been rather more opportunity to give consideration to other matters of a more permanent character. In particular a preliminary survey of the Industry's post-war problems has been undertaken, and it is hoped that further substantial progress may be recorded during the forthcoming year.

There are now District Coke Associations or their nucleus to cover the whole of England, Scotland, and Wales, and it is the policy of the Federation that these Associations shall be autonomous, the Federation acting as the co-ordinating body as between these Associations and for negotiations with other national organizations. This report indicates how progress has been made in these different spheres.

This is the first year that the Federation has been self-supporting by direct subscription from its members. Previously—that is, before District Coke Associations were formed to cover the whole country—the funds were obtained from the National Gas Council, and the Federation's appreciation to the Council for their assistance during that time has been recorded. The secretarial services are undertaken by the London and Counties Coke Association at Gas Industry House.

During the year under review two further national increases in coke prices were authorized by the Ministry of Fuel and Power consequent upon increases in the pithead price of coal in July, 1942, and January, 1943.

Under Board of Trade regulations publication is not allowed of coke production or stock figures, but during the year the production of coke has increased. The Ministry of Fuel and Power are doing everything possible to effect the substitution of coke for other fuels, such as large and sized coals which are in short supply, and welcome the additional coke stocks but, in spite of this, in some areas the stocks of coke have been somewhat embarrassing during the summer months. Those undertakings have been advised by their District Coke Associations that wherever possible they should hold these stocks to meet winter demands.

There is continuous contact as between the Ministry of Fuel and Power and the Federation concerning either national matters or those relating to any one member. In addition, since October, 1942, a regular contact has been established by an invitation for representation from the Federation at a fortnightly meeting of the Merchants Consultative Committee at the Ministry of Fuel and Power. That Committee has representation also from the Distributors through their national organizations. By these means the Federation has been able to make representations to the Ministry regarding restrictions on supplies, and has been instrumental in securing modifications of this in some instances.

The Federation's work with the Ministry on technical matters, particularly concerning the Fuel Efficiency Campaign, has been considerable.

Mr. Leslie O'Connor, Coke Supplies Officer for the Ministry of Fuel and Power, and Director of the British Hard Coke Association, works closely with the Federation, and the Federation appreciates the co-operation it receives from him at all times in coke supply matters. He has expressed the wish that all supply questions emanating from individual undertakings should be referred in the first instance to the appropriate District Coke Association. The co-operation of all gas undertakings in this respect will be appreciated.

It is the policy of the Federation to collaborate with other solid smokeless fuel industries on matters of common interest, and this co-operation has been maintained during the year. A Committee of representatives of this Federation, the British Hard Coke Association, and the South Wales Anthracite and Dry Coal Committee meets at regular intervals, and it has been decided to form a Solid Smokeless Fuels Federation to embody these three Industries. As a Sub-Committee of that there is a Technical Committee of expert technicians from the District Coke Associations of this Federation and from the other two industries.

As a post-war policy in particular it is felt that it is most important for the solid smokeless fuels industries to work together and to develop their individual fuels for their most effective purposes, and also to develop appliances for burning the fuels on a co-operative principle.

Considerable progress has been made during the year in connexion with arrangements with coke distributors. It is the desire of each District Coke Association to form a Distributors' Branch along the lines of those operating in the London and Counties Coke Association and the Midland Counties Coke Association areas. Already the Yorkshire Gas Coke Association has agreed a Constitution for a branch with their distributors. The Federation has always taken the view that co-operation as between producers and distributors is essential for the proper development of the coke market, and that if distributors are to be encouraged to handle coke they must receive a fair and proper reward for their services.

During the year the Federation has received The Institution of Gas Engineers' Report on Coke Quality, and has suggested that the District Coke Associations should recommend to their members that as opportunity affords the sizes given in the report should be adopted. In addition, the Federation has agreed a national definition for coke breeze.

The Federation has a Technical Adviser in the person of Mr. W. L. Boon, and a National Technical Committee to co-ordinate and develop its technical activities has been formed. Its interests are, however, represented on numerous Committees dealing with Fuel Economy, Utilization, Substitution, Development, and Post-War Planning, many of which come under the aegis of the Ministries of Fuel and Power and Works and Planning.

The Technical Committee of the Solid Smokeless Fuels Federation to which each District Coke Association has been invited to nominate a representative is, perhaps, the Committee most directly connected with technical work concerning the Federation, and at the moment it is dealing primarily with development and improvement of coke-burning appliances for post-war production. This Committee is in active contact with manufacturers of appliances, and has liaison with the official Post-War Planning Committees of both Ministries.

The Fuel Efficiency Committees of the Ministry of Fuel and Power are, of course, primarily concerned with the objective of fuel saving, whether in the industrial groups under the Grumell Committees, or the domestic groups under Sir Harold Hartley. Their work, however, impinges on coke and its utilization in many directions and, while the Committees and the numerous panels attached thereto are presumably of wartime tenure, their recommendations will have considerable effect on the permanent policy of fuel utilization.

In the same way, the British Standards Institution has been very active in the production of specifications for wartime purposes; many of these concern fuel in one way or another. For instance, the Emergency Specification limiting Central Heating Plants is obviously curtailing plant which may be used for this purpose, but it has been necessary in framing this specification to safeguard the provision that coke can be effectively used in such plants. It is necessary that matters of this kind should be watched in the interests of gas coke as a whole, for which the Federation is clearly the responsible body, and it is in furtherance of this that the Federation has representation on all the relevant Committees.

In November, 1942, it was agreed to set up a District Secretaries' Committee, of which Mr. C. Bateman is the Chairman, for the purpose of discussing matters of mutual interest and for co-ordinating the work of the various Districts, and the Committee has proved to be very useful in this respect.

Conjoint Conference of Public Utilities

At the Annual Meeting of the Conjoint Conference of Public Utility Associations held on Jan. 26, Lord Falmouth devoted much of his Presidential Address to the coal position. In particular, he criticized the refusal by the Government to consult consumers in any shape or form prior to making increases in or adjustments to coal prices.

Turning to the question of competition between the fuel industries, Lord Falmouth said: "I have always been an advocate of co-operation between gas and electricity. I do not, however, plead for any hide-bound form of co-operation such as would lead to the total elimination of competition and the stifling of initiative; that way stagnation lies." Rivalry between gas and electricity, continued Lord Falmouth, should be friendly and restrained, and not of the cut-throat type which would ultimately harm the interest not only of consumers, but of the two industries themselves; it should not so operate as to deny consumers their complete freedom of choice; and, in the national interest, it should never be allowed to obstruct the most efficient use of the nation's coal. "I should like to see," he said, "in the fuel industries a sense of comradeship in the pursuit of a common aim—the most efficient use of our coal resources."

The Conference re-elected Lord Falmouth President for the coming year, and Lord Pentland and Sir David Milne-Watson were elected Vice-Presidents representing respectively electricity and gas. A third vice-president will be nominated by the water interests.

Following the annual meeting, a meeting of the new Council was held at which Mr. A. E. Sylvester, F.C.A., Managing Director of the Gas Light and Coke Company, was elected Chairman. On taking the chair, Mr. Sylvester stressed the necessity for unity in the coming year, a year which would give rise to issues of great importance affecting each one of the public services—gas, water, electricity, tramways, and hydraulic power—represented on the Council. They had a common and mutual interest which needed to be safeguarded, and the Conference was a valuable means to this end.

Lieut.-Col. S. S. Ogilvie, D.S.O., and Mr. L. W. F. Millis were reappointed Joint Honorary Secretaries to the Conference.

AIDS TO PURIFICATION*

By C. COOPER, M.Sc. (W. C. Holmes & Co., Ltd.)

THE Gas Industry has generally distinguished two stages of gas purification, the wet purification and the dry purification. It has also adhered most faithfully to the present method of dry purification with very little alteration in practice for many years past. Any proposals to diverge to a major degree from the dry oxide box are met with the contention that the process not only does what it purports to do—that is, reduces the H_2S content to a figure below the statutory requirements—but does this with a simplicity and lack of nuisance that cannot be equalled by any alternative process so far proposed.

As regards the inherent simplicity, let us refer to the Paper presented to the Manchester Association of Gas Engineers and Managers by Messrs. Clayton, Williams, and Avery, in 1931, and which was afterwards available in reprint form. This was followed at a later date by other valuable contributions from the same sources. These Papers do not by any means insist on simplicity as the main attribute of successful oxide box operation, but on the contrary they insist on the advisability of careful study to keep the cycle in efficient operation.

How does the wet purification affect the dry purification? The first and most obvious point is whether the removal of certain quantities of H_2S in the ammoniacal liquor assists the dry purification. Under modern conditions the answer must be—hardly at all. In the days of low gas make for high candle-power, the gas would contain a low proportion of CO_2, and a given weight of ammonia might carry off a measurable quantity of H_2S, but we now have, as a general case, gases of high CO_2 content, and the latter tends to monopolize the ammonia in combination. To take a typical case, suppose a gas make of 17,000 cu.ft. per ton, and a recovery of 6 lb. of free ammonia in the liquor. If 2 lb. of ammonia were converted to sulphide, this would be again about 2 lb., or 14,000 grains, representing about 80 gr. per 100 cu.ft. But this is an extremely favourable set of assumptions, and analysis of the liquors in actual production indicates that we can only expect about one-half this reduction in H_2S in practice. It will be agreed that the reduction of initial H_2S by under 10% will not be a matter of much interest as far as operation methods and cost of working are concerned.

Ammonia Washing

The operation of the ammonia washers has, however, a more definite importance, although it may appear to be an indirect one. This is in the matter of allowing a definite though small quantity of ammonia to enter the boxes with the gas. It appears difficult to overemphasize the importance of careful control in this matter. It is comparatively easy to operate a final ammonia washer to pass under 1 grain of ammonia, but comparatively difficult to set conditions so as to pass 5 grains, which may be taken as a desirable figure. It is much more difficult to control at 10 grains, without frequent lapses to 30, 40, or 50 grains. If we assume an 8-chamber washer, with 100 grains of ammonia entering, the estimated water flow—

to give	1	grain	passing	is	0.87	gall.	per 1,000 cu.ft. at 70°.
,,	5	grains	,,		0.58	,,	,, ,,
,,	10	,,	,,		0.48	,,	,, ,,
,,	20	,,	,,		0.44	,,	,, ,,
,,	30	,,	,,		0.33	,,	,, ,,

Here we see that relatively small differences in the rate of water flow procure very great differences in performance.

Another way to regard these figures is to note that the ratio of the extreme rates for water feed is 2½ to 1 (0.87 to 0.33). This ratio is that which represents a temperature rise of only 15°F. Hence, a washer operating on 1 grain outlet would pass to the state of 30 grains slip with a temperature rise of only 15°. The problem of correct adjustment is clearly a difficult one.

I might add that the ever-present necessity to avoid undue addition of water to the liquor make, which is often responsible for the employment of weak virgin liquor in such washers, really intensifies the difficulty. Most such washers are capable of just meeting the requirement of, say, 5 grains ammonia, if the liquor itself has a suitably low ammonia content, but the day and the hour must come when the correct degree of washing is impossible. Who must then determine whether the time has come to add the necessary small quantity of water to correct the condition?

Considerations such as these are behind the introduction of a controller for water supply, which fixes the composition of the liquor contents of the end bay of the washer at such a figure as will give approximately the required ammonia in the outgoing gas. A temperature compensation can also be given over a considerable range. The immediate effect observed has been a considerable increase in the strength of liquor made, simply because no water is wasted during intermission of low gas make, low ammonia content, or favourable washer temperature, and no ammonia is wasted under the opposite conditions.

It is of interest to consider what takes place on works, and there is an increasing number, where gas from coke ovens is being purified, and there is no crude ammonia in the gas to afford these facilities for ammonia supply. In one case a small ammonia distilling plant is in use which delivers a small quantity of free NH_3 from the industrial 25% product, which is probably the most convenient source of supply. The overall cost of this method is very small, as 5 grains per 100 cu.ft. only amounts to about 7 lb. ammonia per million cu.ft. In some cases a quantity of lime is added to the oxide as charged, and ammonia is dispensed with. A possible objection to this practice is that any lime which remains in excess after complete fouling will combine with free sulphur on burning and reduce the value to the acid maker.

Where gas is purified at coke ovens there is always the possibility, if the semi-direct process is in use, of by-passing some unstripped gas to the inlet purifiers, if the saturators do not deliver the required quantity.

While we are on this subject of ammonia into purifiers, I would like to remind you that one result of excess, apart from the disturbance of their functioning, and the added corrosion which may be expected, is that any free ammonia passing out causes chloride loss in the gas dehydration plant, if such a plant is in use. The immediate effect is, of course, to precipitate calcium carbonate in the solution and to form ammonium chloride therein. The solubility of ammonium chloride in calcium chloride is not very great, and many of the observed cases of crystallization in the chloride during cold weather are actually due to the ammonium chloride content.

A certain amount of ammonia can be tolerated at the entry to the dehydration plant. There is a tendency for the ammonia salts to decompose on the evaporator, and the resulting acidification in the bulk is neutralized by the chalk previously deposited in the system. Thus ammonia does not absolutely accumulate in the system.

Tar Fog

The other main impurity with which the "wet purification" is expected to deal, the tar, is another great enemy of efficient oxide purification, as we all well know. We have to refer again to the work of the Manchester Oxide Company's technical staff, and to confirm that every measure which increases the cleanliness of gas at its entry to the boxes is worthy of following up consistently.

The P. & A. tar extractor in its varying forms, and the Livesey washer in its almost standardized form, have efficiencies which are not good enough, as we have been reluctantly obliged to recognize, to give the minimum of trouble from tar fouling. Some undertakings have used both types in series, and others have had up to three Livesey washers in series with good results, but I do not think that anybody is able to quote results from these devices that indicate an efficiency for such machines substantially higher than those quoted by Mr. Clayton and his co-workers. On the other hand, some of the former users of cascades of washers are now using electrical precipitators.

High speed fans have been applied with more success, and this system is known in that most difficult group of gases, producer gas. The method of loading up the tar mist with added water mist is also a useful device, more particularly if we are dealing with tars which will not flow off the deposition surfaces in the normal state.

The idea of cost of electrical precipitation has been much exaggerated. The present Author, writing in 1928, made the observation that the capital cost was about three times that of P. & A. plant, and that the power cost was about 0.1d. per 1,000 cu.ft. on the scale of 5 million cu.ft. daily. It is actually less now. The first note I would like to make is that the resistance overcome in the mechanical types of tar extractors costs money. This is, however, only the beginning of the case, because if we can save any further back-pressure, say, on purifiers, the whole of the saving can be credited, and on any rate of gas manufacture down to extremely small outputs there is a net saving.

Finally, there is the chemical effect, because the presence of tar in oxide prevents full enrichment by reducing the reactive surface, and is later penalized by the buyer, who prefers a tar-free oxide.

It must not be overlooked that there may be other causes of high back-pressure on boxes. The hardening by reason of difficulty in controlling temperature and humidity plays a part in this matter, but we should recognize that tar is a contributory factor. We can measure the cost of back-pressure of mechanical tar extractors, and add the possible extra cost of tar on the oxide, but one hardly likes to generalize the whole question of oxide condition, because the circumstances vary so much at various works, and even climate and degree of exposure have a bearing on the matter.

Gas Heaters

It is another interesting point in purification that its rapidity and completeness are improved by a moderate elevation of temperature, but that, particularly with certain types of oxide, it must be ensured that manipulating the temperature does not create fresh trouble. This may take place if, for example, there is a tendency to dry off the oxide mass by heating. For this reason it has been proposed to employ the gas heater to vaporize water into the gas stream to a slight extent

* From a Paper to the Manchester and District Junior Gas Association.

to avoid the tendency to dry off, keeping in mind that water is generated also by the reaction itself, in the sulphiding stage (Mitchell and Keillor).

In calculating the effects of heat gain and loss in the gases it must be remembered that if the water saturation of the gas changes up or down by evaporation from or by condensation on the oxide, very considerable temperature effects may be found. These effects will be in the direction of preventing the expected temperature change. However, I have to suggest that a good many gas heaters only foster an illusion in the heart of the user, so that it may be they do little harm even when they are doing no good.

For example, the practice is to heat the gas at the entry of the first box. Generally, however, it is just this box that could do without it; if reasonably active it gives an exothermic reaction at a reasonable velocity—*i.e.*, the greater part of the H_2S is fixed in one box. Now the absorption of oxygen lags behind the absorption of sulphur, so much so that the real problem is to effect the re-oxidation of the gas completely in each cycle, yet in few cases is this second reaction considered worth stimulation.

Going further into this, how long would it take to elevate the temperature of four boxes and their contents to any measurable degree, considering the latter three as always losing heat, even if the first is gaining? As the colder box comes into the position of first taker, it is to be heated up by the warm gas plus the heat of reaction. There is a considerable weight of iron plate and oxide to heat up. As a rough estimate, with gas entering at 60°F. above atmosphere, and the absorption of 500 grains in the box, the temperature under average conditions would rise at the rate of 3° per hour. This assumes the gas to remain water saturated, without any evaporation from the oxide.

The losses to air would equalize the heat input of the gas heater when the rise was 15° to 16°. They would stop further rise before 20° elevation, after some 10 to 15 hours.

If now the heat content of gas at 60° elevation is lost when the box is at 20° elevation, what help can there be for a second box treated only with gas 20° warmer than air, and giving very little reaction? This box may have been a little warm when the rotation took place, but it cannot hold this advantage long. A third or fourth box is even less fortunate. It appears clear that only with protection against heat loss, plus reheating between boxes, can full temperature control be obtained.

These quantitative estimates may be assumed to hold for a stream of 1 to 3 million cu.ft. daily. With larger units there are slightly better conditions.

I have already indicated a lack of faith in the possibility of assisting the dry purification by attention to the wet purification, in so far as it extracts some of the H_2S. It is, however, not very foreign to our subject to consider the possibilities of other purification processes, and the alternatives are almost invariably liquid circulation methods. They have an almost invariable property: that they are not capable of giving purification to the town gas standard without subsequent oxide treatment of the gas. Many of them have another common property which I will mention a little later.

Liquid Purification

Probably the most simple of these methods is the Koppers Seaboard process, applied in certain places in the U.S.A. The H_2S is scrubbed out by an alkaline solution, which is capable of giving it up again when the extraction is reversed by exposing the solution to an excess of air or flue gas. We can quite easily see why this process is not reasonably applicable in any ordinary urban area. Various devices have been tried to eliminate possible objections, but none of them would pass the test which we in this country would have to meet, which is: we have already a recognized method of gas purification which successfully does what it purports to do, and creates a certain minimum of nuisance. The alternative process must not be more capable of such nuisance, and the standard, whether an official one or not, is a sound one.

A number of developments of the simple soda process were made, in each case designed to convert the H_2S chemically to free sulphur, thereby achieving the objects of eliminating the nuisance, and providing a product for sale. It appears certain that in each case the added complications, coupled with the fact that the purification was still incomplete, have led to their comparative neglect.

In another group of processes an alkali is employed which reacts with the acid gases in the gas to be purified, and the compounds formed can be decomposed at a higher temperature to release the H_2S and possibly also CO_2, regenerating the medium for recycling. Ammonia is of this class, but the commercial processes usually employ organic ammonia derivatives of low volatility.

These processes exhibit generally the character I mentioned a little earlier without specifying it at the time. They present you with H_2S, more or less pure, in the gaseous form, to deal with as you see fit. Now, what can we do with H_2S gas? It will burn and make sulphuric acid if you have a vitriol plant. It will produce sulphur in a Claus kiln, but I cannot see the likelihood of a great revival of this procedure.

It seems clear to me that the health authorities might have difficulty in accepting the revival of the Claus kiln in urban areas as part of a substitute process for the oxide box method. Consequently, it must be assumed that any liquid purification cycle must "consume its own smoke" effectively, as well as have some merits in the direction of simplicity.

We must agree that the iron oxide purifier as an institution sets a problem in labour, particularly for the small and medium works, where a large unskilled labour gang is not necessarily available when wanted. It has been rather more than hinted that labour will not look more kindly in the future than in the past on this type of employment, and that this should be an inducement to change the system. In passing, I would like to say that this aspect of the matter has not been entirely neglected by the purifier designer, and the greater mechanization of the work of handling and re-handling oxide has already begun. While under conditions of the past few years it has not been found possible to make a competitive tender for what are called tower purifiers, for streams less than, say, 5 million cu.ft., it is quite possible that labour conditions may cause a considerable change in their appreciation. To use three or four men on whole time, with up-to-date mechanical handling, in place of large gangs at infrequent intervals is clearly a desirable step. It is not clear to me why it should be assumed that unless complete fouling of the new oxide is achieved without re-handling, the modern type of purifier cannot justify its cost. On the contrary, it is just in those cases where extra handling is demanded, for one reason or another, not necessarily dependent on the type of box, that the completely mechanized purifier system shows its best advantages. The only installation of tower purifiers in use in this country is now working almost entirely on artificial oxide, and fouling to 50% sulphur at one exposure is being achieved, but this is not to say that such results must always be achieved.

To return to the subject of liquid purification, it has already been noted that complete purification of the gas to the standard test is not claimed or attempted. Here we come up against the necessity of final catch boxes, and it appears to be a matter of general argeement that a box without high initial sulphur content is difficult to keep alive. This is probably the case, but if so, it is a matter which should be studied with a view to improvement, and as a chemical problem it should not be impossible of solution.

The ideal liquid purification system, therefore, should be of reasonable simplicity, and should have some definite product incorporating the sulphur, which can be sold without further handling.

The simplest proposition chemically is not necessarily to convert the H_2S to free sulphur, but to bring it out combined with the only alkali easily available to the gas engineer. There is hardly time to relate all the processes which have been proposed for the purification of gas by producing or using ammonia compounds, although we might particularly note the Feld processes. The simplest of all involves considerable work chemically—that is, to bring the ammonia and H_2S to direct combination as ammonium sulphide.

Use of Ammonia

Earlier in this Paper I indicated the possibilities of reducing the H_2S content of the gas by the ordinary ammonia washing plant and process.

If we take two extreme cases, we shall see how the ammonia and sulphur contents of crude gas are related.

14,000 cu.ft. of gas with 400 grains of sulphur per 100 cu.ft. contain 8 lb. of sulphur, whose combining equivalent with ammonia would be about 8 lb. also. Hence the complete recovery of the ammonia in the form of ammonium sulphide would nearly account for the full quantity of sulphur.

20,000 cu.ft. per ton with 700 grains of H_2S gives 20 lb. sulphur, which clearly could not be combined with less than 10 lb. of ammonia, even in the form of bisulphide, if this compound can be formed.

Either of these assumptions involves the whole of the ammonia including the fixed ammonia, which would need to be released for this purpose by liming.

In an average case it is necessary to contemplate the need to form a certain proportion of bisulphide, and to allow for some of the NH_3 remaining in combination as carbonate. Hence it is probable that the ammonia compounds will not in any given case give more than an aid to the complete purification: the removal of 85% to 90% of the H_2S by this means appears to be about the practicable limit.

A possible adverse aspect is that the sulphur is delivered in a form which is only fully negotiable where the solution of sulphide is afterwards treated for its ammonia in a plant where there is also utilization of the H_2S for acid making, or for the manufacture of free sulphur from a Claus kiln. I find, moreover, that makers of pure ammonia prefer liquors which are low in sulphur, and prefer those with a predominance of carbonate. Hence the revenue from the sulphur may not be as high as it should appear, but it may be noted that spent oxide is not the ideal way to deliver sulphur, and its gross value may decline.

This leads up to a general subject which I have touched on elsewhere. It is the subject of coal by-products as a whole. The social and national advantages of processing coal are often used as advertising credits for the Gas Industry, as against uses for coal which burn it direct. The actual net proceeds of the by-products, other than coke, are not very great, as is easily shown. Each residual has, in recent years particularly, come into competition with other manufactures or products which have removed any possibility of such spectacularly high prices as were once paid for, say, sulphate or benzole. It is unfortunately the case that few of the actual residuals can go into the

chemical market without a good deal of secondary preparation. The Gas Industry, in fact, makes impure chemical substances, and as an idea for early enquiry, one might suggest a search for recovery processes which will bring out more directly marketable substances: sulphur as sulphur, anhydrous liquid or gaseous ammonia, road tars with the lighter oils removed, benzole within the motor spirit specification, as preliminary suggestions.

The contrary policy has been advocated, of course, that the sole product shall be gas, so that even at the cost of reducing the overall quality of gas, the matter shall be simplified, and in fact substantially standardized. It is not necessary to go into this controversial subject now, but I would remind you that no such wholesale treatment with which we are acquainted, or which we can at the present visualize, will dispense with purification from H_2S, and that this job will be better done if the incidental requirements about which I have been speaking are given attention.

Manufacture of Carburetted Water Gas*

By G. MILNER, Ph.D. (Davison & Partner, Ltd.)

(*Continued from p. 125*)

The condenser is a four-pass vertical tubular design with connexions arranged for counter-flow of gas and water, and capable of cooling the gas to within 5°C. of the inlet cooling water temperature when this is at 15°C.

The automatic mechanical operator is of interest in that it considerably reduces the amount of attendance required. The operator controls the cycle of valve operations, each successive cycle being a repetition of the previous one in duration of the blow, uprun, backrun, purge, &c., so that the gasmaker is freed for other duties. Normally no change will occur in the sequence of operation for which the operator is set until this is desired, and the corresponding adjustment made in the setting of cams. Should any untoward circumstances tend to cause any valve to operate in a dangerous sequence, gas-making operations are at once stopped by the emergency shut-down equipment, at the same time bringing an alarm into operation, which continues to sound until stopped by hand. A feature of the operator is that the gasmaker can if he wishes "cut out" the control portion of the apparatus, while still retaining the means it provides for actually moving the plant valves. The gasmaker can then manipulate the plant valves in any way he wishes (within the limits of safety) by simply pulling the requisite control knob provided. Any particular valve can be cut out of operation, leaving the others functioning normally. If the motive power entirely fails the gasmaker can still manually operate the various plant control valves. The valve to be moved should first be selected by pulling the requisite control knob, and then manual power applied by means of a lever, which is common for all valves. The sequence of safety interlocks is still maintained during manual operations of the control valves.

The operator in this installation (as is usual wherever possible) has been installed in the machinery room, where the prevailing atmosphere is much cleaner than that in the generator house proper, thus ensuring a minimum of wear and tear, and at the same time bringing all machinery under the observation of the plant attendant. The instrument panel and control points have also been brought within the machinery house.

Technical Results

It is to be regretted that we are unable to put forward at the present time any technical data on the possible performance of the plant at Kirkcaldy under conditions of continuous operation. A handicap has been the poor quality of gas coals which have been available. Owing to the almost non-caking properties of these coals the coke available for the C.W.G. plant has been small and very friable. After having been forked twice, much of the coke was less than 1½ in. in size. Despite the handicap of small coke, by the judicious choice of cycle and the use of rather more steam than is normally required, the rated output of the plant when making gas of 420 to 430 B.Th.U. per cu.ft. has regularly been exceeded; and for gasmaking periods of approximately 12 hours the metered output of gas has been equivalent to 550,000 to 600,000 cu.ft. per day.

Over a period of five days careful measurements were made of coke and oil consumption and of gas output. During this period all coke charged to the generator was hand riddled over a 1½ in. sq. mesh sieve before bagging. Even then a good deal of breakage occurred before the coke reached the generator. Results obtained were as follows:

Total gasmaking time. hrs. min.	Gasmake per day of 22 hrs. 1,000 cu.ft.	Oil per 1,000 cu.ft. gallons.	Coke for gasmaking per 1,000 cu.ft. lb.	Carbon for gasmaking per 1,000 cu.ft. lb.	Steam per 1,000 cu.ft. lb.	Calorific value B.Th.U. per cu.ft.
52 15	556	1.51	37.8	28.2	63.3	428

Gas Composition, %.

CO_2.	CnHm.	O_2.	CO.	H_2.	CH_4.	N_2.	Calculated C.V.
7.2	5.1	0.0	31.1	42.1	8.4	6.1	435 B.Th.U. cu.ft.

Coke Quality.

% Grading.				Analysis.	
Over 2 in. sq. mesh.	Thro' 2 in. over 1½ in.	Thro' 1½ in. over ¾ in.	Thro' ¾ in. sq. mesh.	Moisture	12.1%
25.0	48.3	20.9	5.8	Ash	8.6%
				Vol. matter	4.5%
				Carbon	74.8%

Therms per gallon of oil (calculated), 1.27 (or 1.32).
Cycle used: Blow, 41.6%; upsteaming, 36.7%; backsteaming, 21.7%; oiling, 18.3%.

* From a Paper to the Scottish Junior Gas Association (Western District).

During the five days of the test, gasmaking took place for less than half the total time. When due allowance is made for this and for the quality of the coke available the results are satisfactory, but not so good as would be expected from the use of uniformly large coke coupled with continuous operation.

DISCUSSION

Mr. J. R. Denoon (Edinburgh) said he would like information on the following points: In connexion with the oil injecting system, how could it be ensured that the jets were kept clear? If the jets happened to become choked, would the oil drop down into the foot of the carburettor? Would it be better to use chequers? Would it be an advantage to install a waste heat boiler on the plant? What about the maintenance of the plant with regard to clinkering?

Dr. Milner replied that in regard to spillage of oil on the floor of the carburettor, there was available visible inspection of the injector itself, and it was quite possible to watch the normal performance of the injector. Assuming that the plant had been put to work satisfactorily and it was found that the calorific value of the gas had declined, while at the same time the oil meter was showing the same amount of oil being injected, it would be realized that something was wrong and a little investigation would soon show the trouble. The type of plant as installed at Kirkcaldy Gas-Works was believed to give better results than with chequered type of carburettor. In addition, the type of structure installed gave a more efficient cracking of the gas, with less wear and tear on the chequer work, and eliminated the possibility of uncracked oil deposited on the chequers being carried back to the generator during the backrun. The advisability of installing a waste heat steam boiler, said Dr. Milner, depended on the relative local cost of fuel for steam raising, and the value of heat they are able to recover from such a plant. Only by working out individual cases could they decide whether a waste heat boiler would be a sound investment or not. Regarding the clinkering operations on the plant, this occupied about half an hour per shift, with a thorough cleaning out of the generator every 2 or 3 weeks, depending, of course, on the nature and quality of the coke used.

Mr. James M. Dow (Kirkcaldy) spoke of his experience with the plant since its installation at the Kirkcaldy Works. He said it was interesting to know that since Dr. Milner's tests had been completed, improved results had been obtained by the introduction of a short blow purge into the cycle. It was now possible to increase the output of the plant to approximately 700,000 cu.ft. per diem, which meant an increase of 32% above the guaranteed figure. He thought that this result was most encouraging, as, to a gas engineer, it was most important that the designed capacity of the plant should be obtained. Further, by the selection of a suitable cycle, the oil consumption per 1,000 cu.ft. had dropped considerably, the minimum weekly average figure being reduced to 1.21 gallons per 1,000 cu.ft. of carburetted water gas made. An effort was being made to reduce the inerts, and here again it was pleasing to report that the total inerts seldom exceeded 11%, the CO_2 averaging between 5 and 5.5%. These improved results had been obtained without any special preparation whatsoever, the fuel supplied to the generator consisting of run of retort coke containing on an average a much higher percentage of ash and smalls than stated by Dr. Milner. It had not been possible to reduce the fuel to the generator below the figure stated in the Paper, but when one took into account that the plant continued to run on an intermittent basis, and that the quality of coal as supplied continued to deteriorate, the results on the whole must be considered highly satisfactory. He felt they had an excellent plant in Kirkcaldy which was meeting all that was required of it under very difficult conditions, and he was sure that once they got back to normal gasmaking coals, results would be even much better. Mr. Dow said he would like to ask Dr. Milner about his method of calculating therms per gallon of oil.

Dr. Milner said the method was that prescribed by The Institution of Gas Engineers in 1938, consisting of taking the gas analysis and separating it rationally into waste gases, oil gas, blue water gas. The calorific value of the blue water gas was then calculated, and this was deducted from the actual calorific value of the carburetted water gas as per calorimeter. The difference was the calorific value of the oil gas, and when this was equated to the number of gallons of oil per 1,000 cu.ft., they arrived at the therms per gallon.

Mr. T. B. Livingstone (Perth, President of the Association) thanked Dr. Milner for his Paper.

LIQUID FUELS AND ORGANIC CHEMICALS FROM COAL AND HOME-REFINED PETROLEUM*

By HAROLD MOORE, M.Sc., F.Inst.Pet.

PRIOR to the present war this country was mainly dependent on imported petroleum for its supply of liquid fuels; while the main source of raw material for synthetic organic chemistry was coal tar, derived from indigenous coal. The dependence of this country on imported liquid fuel has for many years been a source of comment and anxiety. At the end of the war it will be found that the circumstances which existed in 1938 have changed greatly. Hitherto, the supply of liquid fuels and of organic chemicals have been considered as separate issues; they now become branches of the same problem.

During the war years, of the many changes which will be found to have taken place, the two most important will be the reduced financial strength of this country, which will make it imperative to limit the value of imports, and the discovery of technical processes which have made petroleum the raw material for a vast new chemical industry. These two changes necessitate the adoption of some State policy to meet the altered conditions. The problem is largely one of economics, but policy must be based on a knowledge of technique as it exists to-day, and must also take into consideration estimates of the future trend of technical development. The latter requirements call for study.

The primary objects of post-war policy will be—

(*a*) To provide the liquid fuels and lubricants necessary for road transport, aviation, industry, and for the many other essential services at present supplied with petroleum products.

(*b*) To provide raw material in adequate quantity, suitable quality, and low price for the organic chemical industry.

(*c*) To provide the maximum possible amount of remunerative internal work in this country, particularly during the immediate post-war years.

(*d*) To maintain the best possible trade balance—*i.e.*, to import the minimum value of products while giving every assistance to export trades.

The supplies of liquid fuels and raw materials for the organic chemical industry have hitherto been mainly derived from coal and petroleum, the liquid fuels mainly from petroleum, though appreciable quantities have been obtained from coal; while materials for the organic chemical industry have been derived mainly from coal, but, to a smaller extent, from lignite, petroleum, oil shale, vegetable and cellulosic materials, and the animal and vegetable oils.

Though the main raw material for synthetic organic chemistry has been coal tar, the fermentation of vegetable matter has supplied alcohols, esters, organic acids, ketones, aldehydes, &c.—*i.e.*, the simpler aliphatic oxygen-containing compounds. Wood supplies cellulose and such distillation products as turpentine, methyl alcohol, and acetic acid; while the animal and vegetable oils have supplied glycerine, soaps, and fatty acids. But the largest sources of available organic material are coal and petroleum. The production of oil from shale is relatively expensive, and consequently not very important at the present time, but the oil shale may be considered as a reserve supply of mineral oil, available should the supply of free oil become exhausted. The shale oils are very similar to petroleum oils, and could be used as a substitute for most fuel and chemical purposes. As large quantities of coal exist in this country, it is obvious that in order to provide employment and to maintain the best trade balance, coal should be utilized wherever technique and processing costs make it suitable.

The main known methods of making oil and chemicals from coal are by carbonization, which yields a small proportion of liquid fuels, by hydrogenation, and the Fischer Tropsch synthesis, both of which yield large proportions of oils. In addition to these three processes, there is an approach to the organic chemical industry by the manufacture of acetylene, a hydrocarbon particularly suited as raw material for organic synthesis.

Before attempting to formulate any policy for the future, let us examine the position as it existed in 1938.

The Carbonization of Coal

In 1938 (the last pre-war year) 227 million tons of coal were produced in Great Britain. Of this, 38.7 were carbonized, a small quantity (roughly half a million tons) was treated in low-temperature carbonization plants, while the remaining 38.2 tons were carbonized in equal quantities in coke ovens and gas-works. Motor spirit and light oils were obtainable in the carbonization process by stripping the gas, while both light and heavy oils are obtainable from the tar. From the statistics the following yields can be calculated:

	Yields of liquids % by weight.		
	Coke ovens.	Gas-works.	Low-temp. carb.
Tar	4.04	5.50	7.80
Stripper spirit	0.65	0.22	1.12
Total	4.69	5.72	8.92

1938 average, 5.2%.

Gas-works practice leaves much of the benzole in the gas (in order to maintain quality), and this accounts for the relatively low yield of stripper spirit from the Gas Industry. The quality of coal used in these processes will vary, therefore the differences in yields are not entirely due to process conditions.

The total benzole and coal-tar production in 1938 is estimated at slightly over 2 million tons, of which nearly 60% came from gas-works. This tar yielded 12.6 million gallons of benzole, and the total production of benzole and coal spirit was 56.2 million gallons yielded by—

Coal tar	12.6 million gall.	
Stripping coke oven gas	31.6 „	„
Stripping gas-works gas	10.5 „	„
Stripping low-temp. carb.	1.5 „	„
Total	56.2 „	„ (= 220,000 tons).

A further quantity of 42.3 million gallons (140,000 tons) of motor spirit was made by hydrogenation, and together with toluole and solvent naphtha the total production of light hydrocarbons from coal amounted to 112 million gallons, or 440,000 tons. (In the same year 1,460 million gallons of petrol, or nearly 5 million tons, were imported.) In addition, 6.8 million gallons (23,000 tons) of spirit was produced from indigenous shale.

In 1938, approximately 105 million gallons (500,000 tons) of creosote were made and 586,000 tons of pitch.

The carbonization process does not involve great heat losses. The overall efficiency of modern gas-works practice has been found to be over 70%. That is to say, of the heat units entering the process in the form of coal, over 70% leave in the form of gas, coke and tar, even after fuel used in the operations has been provided from the process.

At the present time there exists a fairly complete market for coal-tar products. Any excess benzole over chemical requirements is welcomed, on account of its high anti-knock properties, on the motor-spirit market; occasionally there is an excess of creosote, while pitch is often difficult to sell. Pitch is a difficult problem, as it has largely been supplanted for road making by petroleum asphalt, and it has not hitherto been found suitable for synthetic work, for which purpose it is very deficient in hydrogen. It can, however, be used either directly or in solution as a liquid fuel. Considerable experience of burning this body either as molten liquid or as powdered fuel has been gained during the present war.

Other coal-tar derivatives, such as toluene, xylene, heavy alkyl benzenes, naphthalene, anthracene, together with the phenols and the nitrogen-containing bases, find markets either in the pure state or as bases for the manufacture of other products. If larger quantities were to be produced, any surplus of toluene or xylenes would be readily absorbed by the demand for aviation and motor spirit; while the excess creosote and pitch could be consumed separately or in the form of mixtures on the liquid fuel market as substitutes for imported petroleum oils.

Hydrogenation of Coal

The manufacture of liquids by the hydrogenation process gives high yields on the actual coal hydrogenated, but consumes a large proportion of fuel in the process, consequently the overall yield of liquid is low. In practice, over 3 tons of coal are consumed in order to produce 1 ton of liquid hydrocarbon, and the thermal efficiency has been found to be 43%. This process has been operated on a full-scale commercial unit (140,000 tons of petrol in 1938) at Billingham, but the venture, though a great technical accomplishment, has had to be supported by a subsidy (in the form of tax exemption) of over 200% on the f.o.b. value of the product. The writer believes that for some time past the coal spirit produced by this plant has been made from coal-tar creosote, which means that this process is not increasing the home production of liquid fuel, but merely converting home-produced heavy fuel into light fuel, for which operation the Government paid a subsidy of about £1½ million in 1938. As creosote is largely interchangeable with imported heavy petroleum oil, it means that the creosote consumed has to be replaced by the importation of heavy oil. (Actually the same net effect could be obtained by cracking imported heavy petroleum, a process which is cheaply carried out, but receives no subsidy.) The process is generally too expensive both in money and heat units to warrant its products being used as a large scale substitute for petrol or as a general source of base hydrocarbon for synthesis.

Fischer Tropsch Process

The synthesis of liquid fuels by the Fischer Tropsch process involving the gasification of coke and the subsequent catalytic reaction of carbon monoxide with hydrogen to form hydrocarbons gives similarly low yields and is about equally expensive in operation; but it may become an important process for the manufacture, on a relatively

* From a Paper to the Institute of Fuel, Feb. 1.

small scale, of certain special products, particularly high melting-point paraffin waxes and fatty acids and alcohols which may in time be derived from the paraffin waxes.

The overall thermal efficiency of this process was found to be some 25% some years ago, but with the most modern practice involving the recycling of gas, the overall efficiency may be expected to reach the neighbourhood of 40%, which is very much the same as the hydrogenation process.

The Fischer Tropsch reaction could be carried out much more economically if the plant were situated near a petroleum refinery, where cheap hydrogen, obtained by dehydrogenation, was available, as a large part of the cost of this synthesis is incurred by the manufacture of the hydrogen. The Fischer Tropsch process has not been developed on a commercial scale in this country. The motor spirit obtained by hydrogenation is of good quality, while that obtained from the Fischer Tropsch reaction is low in quality (low octane number). The latter process yields very high quality diesel fuel fractions.

Acetylene.—Another method of preparing hydrocarbons from coal is by the synthesis of acetylene from coke via calcium carbide. Acetylene, besides being of industrial value in the raw state, is an intermediate of great importance, opening up a vast field of synthetic reactions, but the cost of this process is such that though its production in this country is very desirable, acetylene cannot satisfy the general requirements—namely, a cheaply available base for synthetic organic chemistry—nor does it provide us with liquid fuels.

Petroleum.—Petroleum has for many years been the main source of liquid fuels throughout the world, and in 1938 over 90% of the spirit and oils burnt in this country were of petroleum origin, practically all imports.

In round figures nearly 12 million tons of these oils were imported, of which a little over 2 million (about 19%) were in the form of crude, the remaining 81% being in the form of finished or part finished products. The two main products consumed were petrol (over 5 million tons) and fuel oil (3.8 million tons). The cost of these imports was £46 million, or an average of roughly £4 per ton. The finished products' cost averaged £4.35 per ton, the crude £2.35 per ton. These prices include freight, probably about 15s. per ton.

It is impossible to exaggerate the vital importance of these petroleum products, petrol for road or air propulsion, solvents for many industries, kerosene for lighting and heating, gas oil for gas-works and diesel engines, lubricants for all industries and every variety of engineering device, asphalt for roads, transformer oils and a large variety of other commodities.

More than half the crude refined in this country was heavy oil used for the manufacture of asphalt—a comparatively simple process. No preferential tariff operates in favour of the refining of imported petroleum in this country except when refineries manufacture asphalt. Finished asphalt, being a solid substance, has not been subject to the same taxation scheme as the liquid hydrocarbons, and on arriving in the country is liable to the general import tariff of 10%. As the crude can be imported into a bonded refinery without paying tax, the net effect is to give preferential taxation in favour of asphalt refining. Another reason for the practice of refining asphalt in this country is that the cost of transporting crude from the oil-producing centre is relatively low, while asphalt is a solid, and is relatively expensive to transport. Consequently, we find that practically all the asphalt used in this country is refined here.

The distillation of heavy crude usually results in the production of diesel oils and of lubricating oil distillates (usually low grade), and the latter are frequently worked up for the market. Refining for asphalt is a relatively simple process, and the operations involved do not necessitate such expensive equipment as other forms of refining.

Two small independent refineries operate for the manufacture of products other than asphalt; in both these lubricating oils form an important part of the production.

The history of refining in this country during recent years has been a mixture of success and failure. The general result has been that cracking plants have met with little or no success, undoubtedly due to the high loss resulting from the generation of (at that time) unsaleable and unusable gases. Asphalt refining has met with success, due to the preferential position produced by taxation and transport costs. Lubricating oil and general refining has met with moderate success, but the path of the British refiner has been hard and he has received no protection, but has had to buy his materials on a protected and consequently high price market.

Future Policy

We have now made a very brief review of the position in 1938; let us consider policy for the future.

We observe that in the past coal has been carbonized and liquid fuels have been produced without any form of artificial support from taxation. It is true that in recent years the lighter motor spirits have been tax exempt and consequently have been receiving the benefit of a virtual preference, but the industries concerned operated successfully before the motor spirit and heavy oil duties existed. The liquid fuels generated by the carbonization industries are, of course, by-products, and the economics of their production has little dependence upon the price or tax position of the liquids themselves, but is affected by the demands for gas, coke, and smokeless fuel.

If something can be done to increase the quantity of carbonization carried out in this country, it will augment the liquid fuel supplies and increase the total quantity of phenols, cresols, and other organic bases for the chemical industry.

If more coal is to be carbonized it is necessary to inaugurate a campaign in order to increase the use of gas, which should reduce the consumption of raw coal in both domestic and industrial plants, also to encourage the use of gas-works coke for domestic heaters in central heating installations, and legislate with a view to making the use of smokeless fuel (low temperature cokes) in domestic fires more prevalent. The manufacture of coke oven coke is dependent upon the demands of the metallurgical industry, and cannot so readily be expanded by propaganda or legislation.

How to attain these ends is a difficult problem, but the advantages of the change are so far-reaching that the use of the power of the State is fully justified. Propaganda alone would be insufficient, but combined with legislation the desired result should be attained. Such legislation might take the following form:

The qualities of coal used for burning in the raw state would be made subject to control by the Minister of Fuel, and coals would be classified according to their volatile content or suitability for burning in the raw state. The sale of highly volatile coal suitable for carbonization for domestic use would be then prohibited, while a limitation would be placed on the burning of similar coal for industrial purposes. In the first place, very little pressure would have to be exerted, as practically all types of coal would be licensed for external combustion; but as the necessary extra carbonizing equipment was installed and the technique of smokeless fuel production improved (which would be inevitable with increased demand), the restrictions could be tightened by using a stricter specification for controlling maximum volatile contents permissible in coal to be burnt in the raw state. Should some such scheme take effect, we could expect the following results:

(1) An improvement in the overall efficiency of fuel utilization, resulting in some reduction in the quantity of coal mined and thereby a less rapid exhaustion of our greatest natural resource.

(2) Less employment underground, but a very considerable increase in employment in the carbonizing and subsidiary industries.

(3) A great reduction in atmospheric pollution, with its resulting injury to agriculture, buildings, and general amenities.

(4) A considerable increase in the yield of liquid products, particularly liquid fuels for internal combustion engines and materials for organic synthesis.

It might be feared that the increase in the carbonization industry resulting from such a move would result in too great a production of coal tar and thereby depress the markets for the tar products. The likelihood of this occurring is not really serious, and can be entirely prevented by the restriction or taxing of certain imported liquid fuels.

Excess production cannot affect the price of benzole and toluene, as the motor and aviation spirit markets pay a good price for these high anti-knock fuels and are capable of absorbing some 12 times the total present production. Further quantities of benzole will be required for the manufacture of synthetic phenol required by the growing plastic industry and for making styrene, an ingredient of the rubber substitute Buna-S.

Any excess solvent naphtha can also enter the motor fuel market, though it is probable that chemical and solvent requirements could absorb considerably more than the present supplies. Naphthalene is wanted in large quantities for the manufacture of phthalic acid and phthalic anhydride (used in the plastics industry), and further quantities could be readily absorbed. Phenol and cresols are also required for the plastics industry, and can be obtained most economically by direct extraction from the tar.

On examining the position it becomes apparent that creosote and pitch are the only products which will not readily find a market, but they both can be used as liquid fuels for external combustion, and in view of the penny per gallon tax on imported fuel they can command a reasonable price. It might be advisable to give them some further encouragement by increasing slightly the tax on imported fuel.

During the war period considerable experience has been gained in the external combustion of both pitch-creosote mixtures and of pitch. The burning of creosote alone never presented serious difficulty, as it can be burnt in normal oil-burning equipment. Mixtures of pitch and creosote call for extra heating and filtering appliances, but they can be handled and burnt in much the same manner and with the same efficiency as petroleum oil. The burning of undissolved pitch calls for special arrangements for melting and keeping it continuously at a high temperature, consequently it is not advisable to burn pitch alone, unless the installation is reasonably large. At a refinery in the north of England the boilers and tube stills are now heated with pure pitch in the molten state, and the efficiency of combustion is as high as when petroleum oil was being used.

The extension of the carbonizing industry would necessitate increasing the amount of plant installed in this country and the renovation of old equipment—an undertaking which would provide employment during the reconstruction period. We may expect that the main expansion would occur in the gas and low-temperature industries, the magnitude of the coke industry being largely set by the demand for metallurgical coke.

Hitherto low-temperature coke has been sold at relatively high prices, but one might expect that with increase in production and new

equipment the Industry should be able to produce this fuel at lower costs. The entire problem of solid fuel supply and utilization is, of course, receiving much attention from all quarters, and a general programme for increased carbonization involves a detail study of the future policy for electrical power generation and domestic fuels.

(To be continued)

New Central Research Board Suggested

Far-reaching recommendations are made by the London Chamber of Commerce in a report on Scientific and Industrial Research, which was adopted at a recent meeting. The report was submitted by a special committee appointed on June 8 last year, "to ascertain in what manner the Chamber could assist in promoting research in industry." The Chamber has reached the conclusion that in order to galvanize research in this country into full and fruitful activity there are three basic essentials: A centralized and planned direction, through a Central Research Board, a far greater stream of money flowing into research, and a larger, better trained, and better paid staff.

The report suggests that the proposed Central Board should act as a co-ordinating and directing body for all research organizations, and be the link between the Government and the research activities of the country at large. The need for better facilities for specific research on behalf of the small firm is held to be evident.

The Central Research Board should have the right to intervene and require research associations, in consideration of the public funds placed at their disposition, to undertake fundamental research in directions which it judges to be in the national interest, and to require greater activity on the part of associations which, in its view, are proving unequal to their responsibilities. It should be the duty of the Board to consider the effect on national trade and industry as a whole of discoveries of a fundamental nature, and to direct the use of those discoveries so that they may be of the maximum advantage to the nation.

Dealing with finance, the Chamber believes that the universities, as the bodies entrusted with the vital task of carrying on pure research, should maintain a far larger staff than at present of graduates and of skilled laboratory technicians. It is recommended that the number of research fellowships at the universities should be substantially increased.

The Chamber strongly supports the Parliamentary and Scientific Committee in its recommendation that a sum of £10,000,000 should be spent over the first five post-war years in equipping and enlarging university laboratories, and that the programme, estimated before the war to cost £12,000,000, to increase the provision of technical and art colleges, and to expand and bring up to date those already in existence, should be carried out.

Ministry of Fuel and Power

The Minister of Fuel and Power announces that he has appointed Mr. W. W. Marsh, C.B.E., to be Regional Controller for the Eastern Region in succession to Mr. H. H. Holmes, who was transferred to the Headquarters of the Ministry as Director of Services. Mr. Marsh has been Regional Petroleum Officer for the Eastern Region, and was formerly Director of Establishments at the Ministry of Labour.

1944 "Journal" Directory

Page 10. BOSTON. R. C. Wardell, *E. & M.*, *vice* W. C. Chapman, retired.

Pages 122–126. Messrs. W. Coward & Company, Ltd., 3, St. James's Square, S.W. 1, hold agencies also for the following Undertakings: Christchurch and Dunedin, N.Z., Launceston, Tasmania, and Dubbo, N.S.W.

[In the Handbook Section there is an obvious slip in the statement on p. 181 that one ton of new oxide will purify about 200 cu.ft. of gas. This should read 2 million cu.ft.]

Dividend

Wandsworth and District Gas Company.—For the half-year ended Dec. 31, 1943, at the following rates: On the 4% Preference Stock, £2%; on the Consolidated Stock, £2 10s.% (both less income tax at 10s. in the £). This will make the payment of dividends for the whole of 1943 at the following rates: On the 4% Preference Stock, £4%; on the Consolidated Stock, £5%.

The fact that goods made of raw materials in short supply owing to war conditions are advertised in the "Journal" should not be taken as an indication that they are necessarily available for export.

Diary

Feb. 8.—National Federation of Gas Coke Associations: General Committee, Gas Industry House, 10 a.m.

Feb. 8.—N.G.C. Central Executive Board: Gas Industry House, 2 p.m.

Feb. 12.—Scottish Junior Gas Association (Eastern District): Heriot-Watt College, Edinburgh, 3 p.m. Paper by H. B. Avery on "Purification."

Feb. 21.—London and Counties Coke Association: Gas Industry House. Finance Committee, 11 a.m.; Executive Committee, 11.30 a.m.; Central Committee, 1.30 p.m.

Feb. 26.—Manchester and District Junior Gas Association, Manchester: Paper on "Benzole Recovery with Activated Carbon," by R. Walker, H. C. Applebee, and A. K. Howell.

Feb. 26.—Yorkshire Junior Gas Association: General Meeting, Rawmarsh.

Mar. 1.—Southern Association (Eastern District): Gas Industry House, 2.30. Discussion to be opened by Mr. C. H. Chester, O.B.E.

Mar. 25.—Western Junior Gas Association, Bristol: Paper on "High Pressure Storage and Distribution," by B. G. Hawkins.

Twenty-Three of Tilling's Western National buses saved 145,000 gallons of petrol during the past twelve months by running 920,000 miles on producer gas.

"Community Catering in Reading" is the title of a booklet published for the Reading Corporation, giving an account of the communal feeding activities of the Borough in wartime. The use of gas in British Restaurants is prominently featured.

Representatives of the Glasgow Corporation Gas Committee recently attended a meeting of representatives of Scottish municipal gas undertakings, at which it was decided to establish an association of municipal gas undertakings in Scotland, and the Committee has decided to be represented at any further meetings to deal with the formation of the association.

A Ministry of Information Exhibition,[1] "The Evil We Fight," was opened by the Lord Mayor of Liverpool at the Liverpool Gas Company's showrooms on Jan. 28. Mr. C. H. Leach, General Manager of the Company, replying to a vote of thanks, said that the central position of Radiant House in Liverpool made for constant calls on the Liverpool Gas Company for all types of exhibitions, and this was the 27th exhibition to be housed since the beginning of the war.

At a Meeting on Jan. 28 of Edinburgh Corporation Public Utilities Committee, Mr. J. Jamieson, Gas Engineer, stated that the Town Council, in view of the financial position of the Gas Department, had last year authorized a rebate of 33⅓% on the first 5,000 cu.ft. of gas consumed by all consumers in the last quarter of the financial year. He indicated that it would be possible to make a rebate of 50% on the first 5,000 cu.ft. in the last quarter of this financial year—namely, February to May.

Another Canteen, laid out in accordance with the most advanced ideas, and equipped with the most efficient and labour-saving apparatus obtainable, has just been completed by Radiation Limited, this time for a large paper mills in the North. The kitchen is equipped to provide meals for 300 persons, and the canteen apparatus is finished in porcelain enamel. A proportion of the meals prepared in this kitchen is sent out in insulated containers to two additional dining-rooms in the works.

Writing to the Liverpool Press in October, 1942, Mr. C. H. Leach, the General Manager of the Liverpool Gas Company, appealed to the public in Liverpool to use shillings instead of pennies in their meters. There has been a useful response to the campaign which followed in the Press and through the medium of cinemas. During 1943, 4,213 meters were altered to take shillings. The total amount of silver collected has more than doubled, and represents one-third of the total annual collection.

Compiled by Mr. W. Allison Davies, Borough Treasurer of Preston, the 59th annual statement of *Rates Levied in Various Towns*, 1943–44, together with charges for gas and water supplies, affords a concise index of the rate trend in most of the larger cities and towns of Great Britain. Although prohibitions regarding the publication of information relating to certain aspects of local govenment and some utility services have prevented the inclusion of all the usual statistics and reduced the number of columns from 67 to 35, the statement is still of considerable value to students of local government. Rates throughout the country remained fairly steady compared with the previous year, and while there have been local rises and falls, the average for county boroughs at 14s. 8½d. is only 1½d. lower than in 1942–43, and in both municipal boroughs and selected urban districts (at 13s. 7¾d. and 15s. 2¼d. respectively) the average is ¼d. higher than a year ago. Comparative figures for the price of gas are not given.

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GAS PRODUCTS PRICES

The London Market Jan. 31.

All Coal Tar Products are in good demand, and Pitch in the London area remains about 45s.

The new Coal Tar Products Prices Order, 1943 (S. R. & O. 1528), came into force on Nov. 15, fixing the prices at which Coal Tar Oils may be sold for various specified purposes. It also confirms the prices which may be charged for other Coal Tar Products under earlier Orders.

An Order entitled The Control of Toluene (No. 3) Order, 1943 (S. R. & O. 1943, No. 976), came into force on July 20, and introduced certain changes in the prices for different grades of Toluene.

There are no changes to report in the prices of Coal Tar Products.

The Provinces Jan. 31.

The average prices of gas-works products during the week were: Pitch and Crude Tar,* Toluole, naked, North, 90's, 1s. 11d. to 2s. 1d., pure, 2s. 7½d. (controlled by the Control of Toluene No. 3 Order, dated July 14, 1943, operative from July 20, 1943). Naphtha and Xylole controlled by the Coal Tar Naphtha and Xylole Order, 1943, dated May 31 (S. R. & O., 1943, No. 768), operative from June 1. Carbolic acid, 60's, naphthalene, anthracene, creosote oil (hydrogenation), coal tar oils (timber preservation, &c.), and strained anthracene oil controlled by the Coal Tar Products Prices Order, 1943, dated Oct. 20, 1943 (S. R. & O. 1943, No. 1528), operative from Nov. 15, 1943.

* In regard to pitch and crude tar prices we would ask readers to refer to the editorial note on p. 396 of the "JOURNAL" for Sept. 10, 1941.

Scotland Jan. 29.

Deliveries have been well maintained during the week. Refined tar*: Yield to Distillers is 4½d. per gallon *ex* Works, naked. Creosote oil: Timber preserving quality,* 5½d. to 6½d.; hydrogenation oil,* 5⅞d.; low gravity or virgin oil,† 7¼d. to 7½d.; benzol absorbing oil,* 6½d. to 8d. per gallon. Refined cresylic acid,* is 3s. 6d. to 4s. 6d. per gallon *ex* Works, naked, according to quality. Crude naphtha†: 6½d. to 7d. per gallon. Solvent naphtha*: Basic prices delivered in bulk, 90/160 grade, 2s. 8d., and 90/190 Heavy naphtha, Unrectified, 1s. 10½d.; Rectified, 2s. 3d. per gallon. Pyridine†: 90/160 grade, 13s., and 90/140 grade, 15s. per gallon.

* Price controlled. † Uncontrolled.

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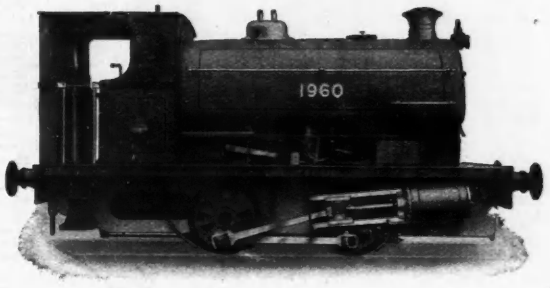
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